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C O N T E N T S

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GEOLOGICAL SOCIETY OF MALAYSIA

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GEOLOGIC NOTES

Mass Movements in the University of Malaya Campus, January 1971

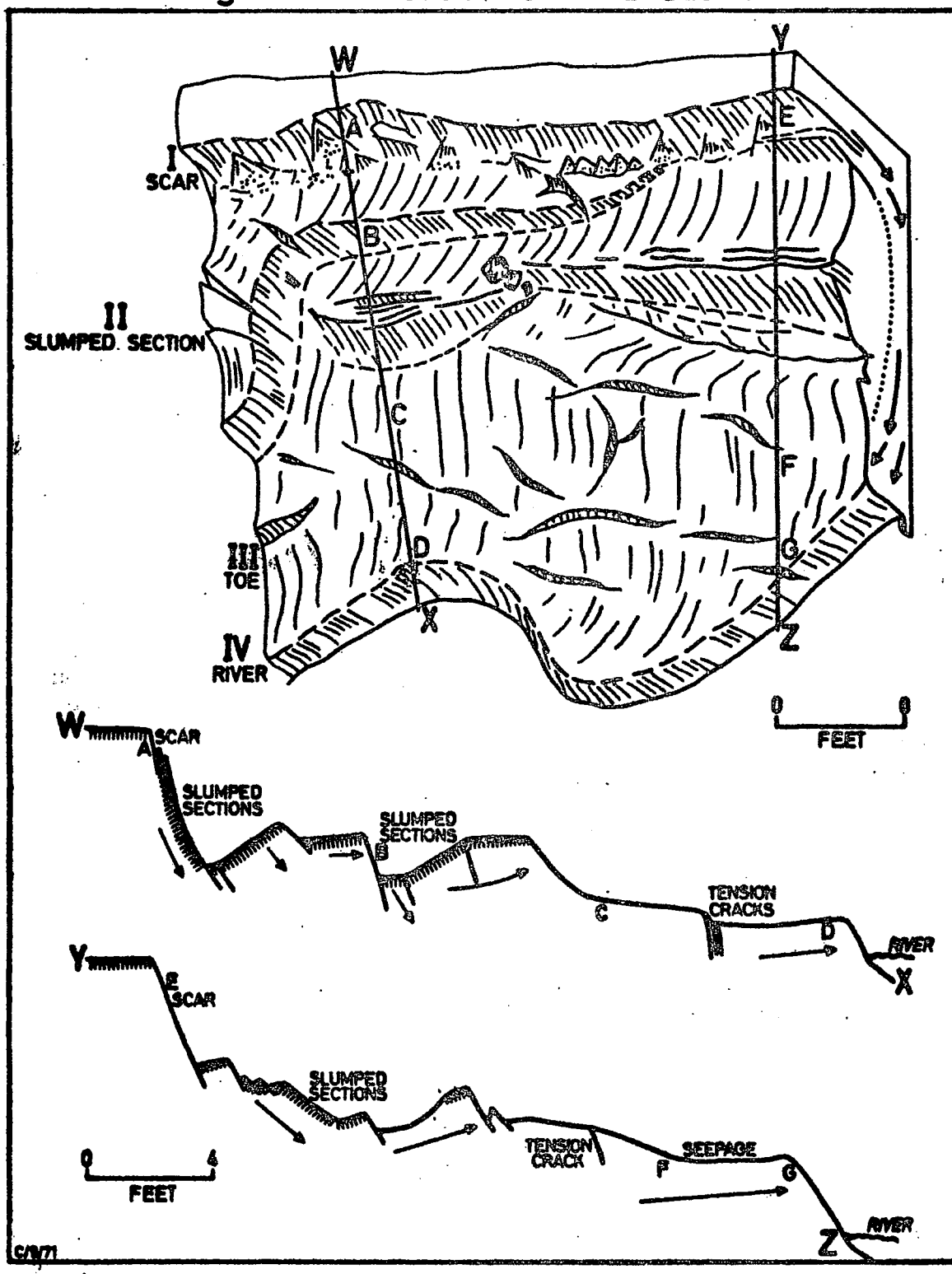
E.A. Olofin and R.P.C. Morgan
University of Malaya

In the 24-hour period from 0900 hours on 4 January, 6.14 inches of rain was recorded at the University of Malaya campus, following 3 days of almost continuous rain during which 4 inches fell. The rains, associated with a slow-moving depression which produced widespread flooding and induced numerous mass movements throughout West Malaysia actuated three main movements and many smaller ones within the campus. The main movements, one on the river bank close to the western edge of the Dewan Tunku Chanselor, one near the Faculty of Agriculture ponds close to the Fifth Residential College, and one between the Geology building and the Arts Faculty, have certain features in common.

Firstly, all the movements are on man-made slopes. Secondly, there is always a water course at the base of the slopes. Thirdly, the movements correspond to the type described as 'earthflows characterised by slumping' (C.F.S. Sharpe, 1938). The movement between the Geology building and the Arts Faculty was studied in the field on 8 January when its main features were mapped and soil samples taken for grain size and moisture analysis. The area covered measures about 40 by 30 feet and the local relief between the stream bed and the top of the back scar is about 9 feet. Three main morphological units can be recognised (Fig. 1); the slump scars at the head; a central area of slumped material; and a gently sloping toe area.

The back scar is about 4 feet high and ends in the slumped section at its base. The scar shows some diversity in miniature features, being a clean-cut free-face in part but elsewhere possessing small talus cones at its foot. In some localities slabs which have not yet fallen retain a connection with the backwall at their base but are separated from it by a deep vertical fissure at their top. The slumped section is only slightly buckled and disrupted and consists of two back-sloping areas with small secondary scars. Numerous cracks and ridges provide a micro-relief. From the foot of the slumped section the land slopes gently though unevenly towards the stream, and tension cracks parallel to the scar-lines are visible on the surface. A line of brown staining and damper ground marks a small water course which issued from the base of the slumped unit, crossed the toe unit and initiated some slumping at its junction with the main stream. Immediately at the stream edge, the toe ends in a small rise or ridge which forms the river bank.

Fig. 1 MORPHOLOGY OF THE SLUMP



The surface soil is essentially a sandy clay loam (Table I) and both texture and moisture (determined by weight-loss on drying) are relatively uniform throughout the area except on the rise in the toe unit where the material is a clay loam and considerably wetter. The moisture figures, taken three days after the movement have no absolute significance, but their relative magnitudes are probably representative of local differences in soil properties.

TABLE I

Soil properties at locations shown in Figure 1

Position	Clay	Silt	Sand	Moisture	Height above river (feet)
	Weight Percent				
A	25	23	52	15	8
B	26	19	55	16	5
C	26	19	55	21	3
D	25	17	58	21	2
E	28	25	47	22	8
F	28	20	52	23	3
G	38	14	48	32	1.5

Several factors combined may have initiated the movement. Firstly, under conditions of continuous but not intense rain the underlying clay loam becomes thoroughly lubricated. Saturation occurs partly because of the nature of the material and partly by its proximity to the water table and the river. Secondly, following saturation, the soil above continues to absorb water thereby increasing the weight of the overlying layer, which exerts a squeezing effect on the saturated clay loam, causing it to flow downslope towards the river. The removal of this support induces slumping of the material above. Thirdly, the river may have contributed to instability by undermining the slope. Fourthly, vibration may serve as a trigger mechanism, although this is likely to be of greater significance in terms of the other main movements in the campus which are near to the main roads.

These factors acting together produced a classic example of association of flowage and slumping. The flow seems to have been largely subsurface as indicated by the similarity of the surface soil on the toe to that on the backwall of the main scar. It is only on the bulging rise at the base of the toe that soil properties differ. Further evidence of subsurface flow is provided by the tension cracks on the surface of the toe unit. The slumping occurred along a rotational slip plane accounting for the vertical scar and the backsloping upper surfaces of the slumped unit. The complete movement appears to have narrowed the course of the river although the extent of the narrowing cannot be determined because of the lack of reliable information on the nature of the area before movement occurred.

Acknowledgements

The authors thank Miss Low Kwai Sim and Mr Goh Kim Chuan for their assistance in the field.

Reference

C.F.S. Sharpe, 1938. Landslides and related phenomena. New York.

An Occurrence of Malayaite ($CaO.SnO_2.SiO_2$) at Rawang, Selangor, West Malaysia.

K.F.G. Hosking, E.B. Yeap and T.W. Wong
University of Malaya

A number of samples collected by one of us (T.W. Wong) in 1970 from a tightly folded band of skarn in the Hiap Huat Mine, Rawang, were examined under short-wave ultraviolet light, and two of these, which were obtained only a few inches away from a 20 foot thick micro-adamellite dyke which had invaded the calcareous rocks, were found to contain a mineral which fluoresced greenish-yellow. Subsequent study of thin and polished sections of these two specimens confirmed that the mineral was malayaite, $CaO.SnO_2.SiO_2$. Details of this occurrence of malayaite have not hitherto been published although a brief mention of it has been made earlier (Hosking and Yeap, 1971). As will be seen from what follows, these specimens are of particular interest in that by their examination it has been possible to throw a little more light on the malayaite/sphene isomorphous series.

Minerals associated with the malayaite which were identified in thin sections are vesuvianite, diopside, epidote, sphene, alkali feldspar, chlorite, fluorite, calcite and quartz. Loellingite was identified in polished sections. The occurrence of feldspar in the Malaysian skarns is not particularly common and so is worthy of mention.

The malayaite occurs as small spindle- or diamond-shaped euhedral grains, never more than 300 microns in length, and is confined to certain areas of the skarn specimen which are defined below. Closely associated with the malayaite are sphenes which also show a similar habit and which possess optical properties similar to those of the tin-bearing species, but which, unlike it, are non-fluorescent. Differentiation between the two minerals in question could only be made by examining, under the microscope, uncovered thin sections irradiated by short-wave ultraviolet light.

Whereas the vesuvianite, diopside, calcite and some of the feldspar are confined to what are probably cataclastically developed angular rock fragments, the remaining minerals, all of which are fine-grained and which include the malayaite and sphene, tend to occupy the areas between these fragments and to invest crudely the latter. From this spatial relationship it is concluded that malayaite was one of the latest of the silicates to be deposited, and that it, and, indeed, all the fine-grained inter-fragment species, were probably the products of metasomatic processes induced by the invasion of the 'proto-skarn' by hydrothermal solutions rich in silica and containing such elements as tin, titanium, and arsenic. When fluorescing grains or crystals of what, under low magnification, appear to consist wholly of malayaite are examined under higher magnifications, it is clear that many of them are not mono-mineralic. Some parts of a given grain may be strongly fluorescent, whilst others fluoresce only weakly or not at all. Crystals with non-fluorescing cores and fluorescing rims are also much in evidence. Under transmitted white light it is not possible to detect this lack of homogeneity.

The above observations suggest to the writers that members of the isomorphous malayaite-sphene series will, when appropriately irradiated, display fluorescence that is capable of being detected by the eye, when a certain (unknown) percentage of tin has substituted for titanium in the sphene lattice, and that the intensity of the fluorescence will increase up to a maximum with increasing substitution, although the maximum may be reached before the substitution is complete. This view was first expressed by one of us (K.F.G. Hosking) after he had examined "malayaite" from Chenderiang (Perak) which was characterised by possessing alternate fluorescent and non-fluorescent zones (Hosking, 1970, p.41). Further work concerning this problem is in progress, and it is hoped that an electron-probe analysis of the Chenderiang material, which is about

to be carried out, will go far towards providing a quantitative solution to it.

References

Hosking, K.F.G. 1970 (Oct.). The primary tin deposits of Southeast Asia. Minerals Science and Engng., S. Africa, 24-50.

Hosking, K.F.G. and Yeap, E.B. 1971 (Jan.). Geol. Soc. Malaysia Newsletter, no. 28, 1-4.

CONFERENCES

Regional geology of Southeast Asia (Preliminary announcement).

The Council of the Geological Society of Malaysia has approved in principle, a proposal by the President to hold a regional conference of the Regional geology of Southeast Asia, in Kuala Lumpur from 20 - 25 March 1972. The conference would deal with various regional aspects such as tectonics, stratigraphical and palaeontological correlation, zones of mineralization, and younger sedimentary basins and associated oilfields.

Fuller information will be made available in due course. Meanwhile the Council would welcome any suggestions from members as to the scope of the conference.

- NSH

Third International Gondwana Symposium.

The Gondwana Subcommission of the IUGS has approved a proposal to hold the third meeting of Gondwana Specialists in Australia from 6 - 11 August 1973 under the sponsorship of the IUGS and the Australian Academy of Science. Interested persons are invited to apply to the Australian Academy of Sciences, P O Box 216, Civic Square, Canberra, ACT 2608, Australia, for the First Circular, which will be issued in 1972.

- NSH

NEWS OF THE SOCIETY

Annual General Meeting

The Fifth Annual General Meeting and Discussion Meeting were held in the Department of Geology, University of Malaya, on 12 and 13 February 1971. The President, Professor K.F.G. Hosking opened proceedings with his address, 'The search for tungsten' which will be published by the Society shortly. Following previous practice, no theme was followed by the Discussion Meeting and an assortment of papers was presented. Those dealing with jade attracted considerable interest, and the idea that to enjoy jade to the full, it was necessary to feel it and rub it particularly appealed to members. The titles of papers presented are listed below and abstracts, where provided by the author, are dispatched separately with this Newsletter.

Papers presented at the Discussion Meeting:

Bevels and breaks of slope at Bukit Ayer Hitam, Puchong, Selangor - R.P.C. Morgan

Some notes on deposits of the January 1971 floods in Kuala Lumpur - P.H. Stauffer

Bedrock stratigraphy of the Rawang area, Selangor - T.W. Wong

A revision of the age of the Kekneno tectonic unit in Timor (Indonesia) - S. Sartono

Geology and mineralogy of jade - N.S. Haile

The significance of jade in Chinese culture - S.M. Lee

Mapping the sea-floor sediments by a simultaneous use of echo sounder, strata profiler and transit sonar - Nik Mohammad bin Nik Abd. Majid.

Speculations on plate tectonics in the northwest Pacific - R.W. Murphy

The Annual General Meeting was held late on the morning of 13 February. Reports of the President, Secretary/Treasurer, Assistant Secretary and Editor are being sent with this Newsletter.

The Society dinner held at a restaurant in Petaling Jaya attracted about 30 members and made a most enjoyable evening.

RPCM

Field Trip after AGM

After the two-day Discussion Meeting and AGM of the Society, a half-day field trip was held on the morning of Sunday, 14th February. Some 17 members attended this trip, which was to the quarry of Pan Malaysian Cement, Sdn. Bhd., at Rawang, Selangor. The party examined the bedrock geology of the quarry, which includes four distinct lithologic units, in two sequences separated by a major unconformity. The three units below the unconformity (which are possibly Lower Paleozoic by lithologic and structural correlation with the Kuala Lumpur area) are tightly folded; the unit above the unconformity (possibly Permo-Carboniferous) is gently folded. All the units are cut by faults.

Meetings of 9 and 13 March

Dr G. Aleva, Chief Geologist of N V Billiton, gave two talks on aspects of the geology of tin to the Society, in the Department of Geology, University of Malaya. In view of the great interest in this topic to many of our members, we are including rather fuller accounts of these talks than is usual.

At the meeting on 9 March Dr Aleva spoke on "The geology and tin deposits of Rondonia, Brazil", and illustrated his talk by about 40 slides.

Rondonia is located in west Brazil. Topographically the region is very flat and is believed to be developed as the result of possibly 2 or 3 cycles of peneplanation superimposed on each other. Very limited geologic mapping of the area has been carried out so far. Geology of the area is imperfectly known due also to the lack of exposures in this flat and deeply weathered region. Essentially the area has a Pre-Tertiary Basin sitting on top of a Pre-Cambrian Basement or Shield.

Basement rocks are mainly of gneisses, schists, quartzites, gneissic granites, and metamorphosed basic dikes. The gneisses and schists occupy low lying areas while the quartzites form low ridges. Two episodes of granite intrusions have been recognised; one dated as 1500 m y while the other, known as the Younger Granites was dated as 900 m y. These Younger Granites formed rounded hills which were shown as circular patterns on aerial photographs. Some porphyries with rhyolites occurred also. One occurrence of diabase was encountered in a well-digging operation.

The Pre-Tertiary Basin rocks comprise approximately 80 meters of conglomerate and sandstones. Remnants of these were represented

by isolated sandstone hills. The basal conglomerate of the basin rocks contained locally some cassiterite derived from the Basement.

The association of tin with granites has been propounded by many people. In Rondonia though there were many areas of granites, a few localities only produced tin. Only one new tin locality has been found since 1962. Tin in Rondonia is invariably associated with topaz. Minor amount of tourmaline is also commonly found. Some primary quartz-cassiterite-topaz veins were observed in the bedrocks. Cassiterite there is black in colour.

Economic cassiterite deposits in Rondonia are confined to the present river valleys. In Bangka, Indonesia, often the alluvium developed in the valley is around 20 feet thick, and at the base of this alluvium a tin-rich "kaksa" (a term used in Bangka) layer is found. However, in Rondonia often below this kaksa layer up to 100 feet of tin-bearing alluvial deposits may be present before bedrock was reached. The development of such deep alluvium in limestone areas such as in Malaya is understandable, but not in the case of Rondonia where the topography is very subdued and the bedrock is not limestone. The tin-bearing sand below the kaksa layer could have developed during an earlier cycle of penoplanation.

Before the arrival of the Billiton Company the alluvial cassiterite was exploited by the local people using rather primitive methods. Square pits were dug into the alluvium until tin-rich layers were reached. The tin was then extracted by panning. Often values of tin might be as high as 3 katies/cu. yd. The Billiton Company introduced hydraulic mining there. Prospecting by the Company was carried out by Bangka drilling, on target areas located from airphotos.

Mining operators are still faced with a great number of problems. Mines are isolated. Food and materials have to be transported for long distances. Medical facilities are virtually unknown while diseases such as yellow fever and malaria are prevalent. Cassiterite mined has to be transported out by small aircraft.

A lengthy discussion followed. The following are a few points which were brought up:

Hosking: How does the primary tin occur? As greisen-bordered veins?

Aleva: Details are not known, but masses of greisen materials and lumps of cassiterite with mica-rich patches have been found.

Hosking: What is the habit of the cassiterite?

Aleva: Short primatic.

Haile: Is the area dredgeable?

Aleva: At two Billiton prospects there is sufficient yardage to warrant dredging.

Haile: What is the total production and the potential? Is it as big as Kinta?

Aleva: No, not anything approaching the scale of Kinta.

W.K. Lee: What was the drilling grid?

Aleva: 300 feet interval along the valley and 30 feet across. For larger valleys it was 600 feet and 30 feet respectively.

M.K. Choo: For the present existing mines what is the average sediment depth and grade?

Aleva: Average depth is 20-40 feet and average grade around 1.7 katies/cu. yd.

Hosking: Is the mineralisation of Rondonia very similar to that of Nigeria?

Aleva: Very similar

R.P.C. Morgan: Has anybody done any work on the various peneplanation levels?

Aleva: No results yet. Studios now being carried out.

CMK and EBY

In the second of his talks, on 13 March, Dr Aleva spoke on "The placer deposits of Billiton Island, with a consideration of genetic aspects, and a comparison with other deposits of the Far East".

The landscape of Bangka and Billiton, in contrast to that of Malaysia, is a very flat peneplain from which rise a few isolated hills of igneous rocks and quartzite. The intrusive plutonic rocks of Billiton range from gabbro to granite. The gabbro contains very basic plagioclase with cores of An_{90}, and rims An_{20-40}, without intermediate zones, and some specimens have interstitially as much as 10 percent K-feldspar and 30 percent quartz. The feldspars in the intermediate rocks (granodiorite and adamellite) are also somewhat anomalous in the calcic nature of their cores. Crystalloblastic texture is typical. Only the granitic rock seems to be related to tin deposits.

Most of the Billiton island is composed of schistose shale and sandstone without limestone (except for one offshore occurrence).

Pillow lava and tuffaceous rock crop out over a small area along the north shore. The regional strike is about 090°, and the dip is steeply towards north, with probable isoclinal folding.

More than two-thirds of the tin won in Billiton is from areas with schist and shale bedrock. Rich deposits seem to be associated with small granitic intrusions, and are probably centred around cupolas. Very little primary cassiterite is seen; possibly most has been eroded. Thin quartz-mica veins with some cassiterite is typical; in a few places larger masses of greissen contain topaz, tourmaline, albite, quartz, micas, and cassiterite. A few wider quartz-mica veins contain cassiterite and wolframite. In the sedimentary rocks, quartz veins with cassiterite are typical; a few rare veins of almost pure cassiterite as much as 1 m thick have been found. The cassiterite in sedimentary rocks is dark-grey to yellowish; that in granite is reddish and pleochroic.

Some sulphide veins are known in the Kelapa Kampit lode mines, where cassiterite occurs in bedding-plane and cross-cutting veins in schist, with chalcopyrite, galena, pyrite, arsenopyrite, haematite, and magnetite. The copper content of much of the discarded gangue was as much as 2-3 percent! In the east of the island a 30 m vein of massive magnetite contains 1-2 percent SnO_2, but has not been worked.

Deposits in Billiton are of several types. Besides lode deposits, almost all deposits are of residual type, and may be described as residual elutriational deposits. On gentle slopes superficial deposits known as "kulit" deposits have been worked, and appear to represent local dispersion by gravity creep and soil wash. In river valleys the rich sections are usually confined to the basal layer of angular residual gravel or "kaksa", with a few stanniferous sand lenses higher in the valley deposits being the only truly alluvial placers. It is clear that tin has moved down into the valley from the sides but has not been transported significantly along the valley.

Billitonites (tektites) occur in the gravel, and have been dated at about 500,000 years B.P. Probably some of the tin deposits are of this age.

Offshore from Billiton cassiterite in Quaternary deposits is confined to valleys and gullies cut into bedrock, and is absent on terraces and platforms. It appears that wave action has swept the tin, left over the whole surface by eluvial processes, into the gullies. At one place of northeast Billiton a hole (Belinu No. 7) over 100 m deep yielded much cassiterite. Permo-Carboniferous limestone was found in the base of this hole, which is evidently a sink-hole, like those common in West Malaysia.

On Singkep island deposits in river valleys followed out to the shelf continue to contain workable tin for only 500 m beyond the last exposure of probable source rock, and this is probably the normal limit for transport along rivers in areas of low relief.

In Renong, Thailand, the type of deposit is very different from that in Billiton, since cassiterite is found dispersed over a coastal plain. No primary mineralization is known under the coastal plain, and the source is in granite hills some 10-16 km inland. The deposits and the contained cassiterite become gradually finer away from the source, and it is clear that the cassiterite there has been transported by sheet floods, and torrents, and sorted by river and wave action.

At Thai Muang in Thailand, placer cassiterite also occurs on a coastal abrasion plain, but there the tin is residual, with remains of the weathering crust still seen.

The question now to be answered is: will tin be found in the deeper valleys (up to 100 m below sea level) known in offshore areas of the Sunda Shelf? From knowledge of the deposits on land and immediately offshore it is clear that three factors mainly control the production of workable placer deposits in this region:

1. Chemical weathering. This is essential to free the cassiterite, especially in granite areas where feldspars break down into clays.

2. Concentration. The freed cassiterite needs to be concentrated, and this often comes about by removal of the decomposed country rocks as clays, and of fragments of the less dense quartz and other minerals.

3. Existence of traps. Traps to retain the concentrated deposits are important. These may be valleys, hollows, or in limestone areas, sink-holes. In peneplaned areas the "kaksa" itself acts as a trap to retain cassiterite in between the coarse angular fragments of quartz.

Taylor: Has any work been done on the tin content of fresh bedrock?

Aleva: Not much has been done in Billiton. No cassiterite has been found in the granite itself, only in greisens and other veins.

Nik Mohamed: What is the depth of the offshore valleys shown on sonar records? Is the tin in offshore valleys derived from granites on land?

Aleva: The valley bottoms shown are as much as -90 m deep in an area where the sea bottom is -40 m. With a few exceptions (noteably Renong) cassiterite in workable deposits has usually travelled less than 500 m. Therefore any new offshore tin deposits which may be found will be likely to have a local source.

Taylor: In my experience cassiterite in residual deposits is poorly sorted, whereas transported tin is much finer, and is well sorted.

Aleva: Yes, that is so, and sorting may be an useful criterion to determine probable distance of transport.

- NSH

Mineralogical Sub-group

Following the acceptance of the sub-group as a member of the International Mineralogical Association, announced at the A.G.M., it is now necessary for the sub-group to nominate representatives on the various commission of I.M.A. The full list of commissions is:

1. Commission on Abstracts
2. Commission on Cosmic Mineralogy
3. Commission on Mineral Data
4. Commission on Museums
5. Commission on New Minerals and Mineral Names
6. Commission on Ore Microscopy
7. Commission on Teaching

Mr J.H. Leow, Chairman of the sub-group will be contacting members to arrange for the election of representatives. According to the Society's records, the following are members of the sub-group:

Full members: R.F. Allbrook; P.C. Aw; F. Chand; C.C. Choi; E. Escande; C.S. Hutchison; D. Lee; J.H. Leow; A.P. Ng; D. Santokh Singh; A. Spykerman; H.T. Tan; S.C. Toh; C.H. Yeap

Student Members: Nik Mohamed; C.C. Voon

Membership of the sub-group is open to all members of the Society and any member who wishes to belong is invited to contact the Secretary.

Membership

The following have been elected full members of the Society:

Mr S.H. Huchan
c/o B.P. Singapore Pte. Ltd.,
P O Box 2814, 1 Pasir Panjang Road
Singapore 5.

Mr G.M. Evans
Apartado 5344, San Jose
Costa Rica, C.A.

The following student member has been elected a Full member:

Mr Khoo Han Peng
Geological Survey Department
Bentong, Pahang.

Changes of Addresses

Mr L.V. Hull
c/o Continental Oil Co.
P O Box 5157, Lake Charles
Louisiana 70601, USA

Mr Gan Kim Shin
c/o Malayan Tin Dredging Ltd.
Kampong Gajah Section
Tanjong Tualand, Perak

Dr C.R. Jones
6 Scholars Close, St Peters Ave
Caversham, Reading
Berks, U.K.

Mr Lee Mun Kit
c/o Placer Prospecting
P O Box 1307, Mt. Isa
Queensland 4825, Australia

Dr C.K. Burton
1 Djalan Sunda (Pav.)
P O Box 183, Djakarta, Indonesia.

Addresses unknown:

The Secretary has been unable to contact the following members and would be grateful for any information on how to reach these people:

Mr J.H. Evans-Jonthan (formerly c/o EMMCO, Bukit Besi Mine, Dungun, Trengganu, Malaysia)

Mr G. Jacobsen (formerly P O Box 123, Kainantu, New Guinea
also P O Box 1229, Boroko, New Guinea)

ERRATA

Newsletter 28:

Peridodite-gabbro problem, M.K. Leong. page 4, para. 1, line 3, should read as follows:

> Dr Fitch in the November Newsletter reiterated his opinion as expressed earlier in Memoir 4 (Fitch, 1955) that the banding in the "banded diorite" of the Segama area is similarly igneous in origin. Both Drs Thayer and Fitch believed that the Silumpat Gneiss and the "banded diorite" are contemperaneous .."

page 6, para. 3, line 13: for "nearly" read "nearby"

page 6, para. 3, line 15, 16: delete "the gabbros to epidiorite may be spatially related to"

page 7, para. 5, penultimate line: for observed read obscured.

page 10, Reference to Gervasio, F.C., 1966, should read:

> "The age and nature of orogenesis of the Philippines. Philippine Geologist, 20, p.121-140".

- NSH

RESIDUAL DEPOSITS by Kaksa

A paper in a recent Geol. Soc. America Bulletin (vol. 81 p.110) is entitled "Submersible observations in the Straits of Florida: Geology and Bottom Currents". Presumeably written in waterproof ink?

The bibliography of a recent USGS Project Report on Indonesia lists a paper by Ringkasan in the bibliography. Is this an up-and-coming young Indonesian geologist or a relative of the well known Dr Abstract and Professor Summary of the English-speaking world?

From the academic world:

"Turbidity currents once destroyed the transatlantic telegraph poles".

"Grain size influences the rate of weathering: a large boulder is more likely to be hit by a raindrop than a tiny pebble, and so the boulder will weather faster."

"Tsumanis wrap around islands and on the opposite side they form a hilo".

"William Smith took a study course of 24 years and finally drew a geologic map of England".

THE COPPER MOUNTAIN OF TIMOR - Part I

I arrived at Delli, the capital of the Portuguese possessions in Timor, on January 12, 1861, and was kindly received by Captain Hart, an Englishman and an old resident, who trades in the produce of the country and cultivates coffee on an estate at the foot of the hills. With him I was introduced to Mr Geach, a mining-engineer who had been for two years endeavouring to discover copper in sufficient quantity to be worth working...

On the 24th of February my friend Mr Geach left Timor, having finally reported that no minerals worth working were to be found. The Portuguese were very much annoyed, having made up their minds that copper is abundant, and still believing it to be so. It appears that from time immemorial pure native copper has been found at a place on the coast about thirty miles east of Delli. The natives say they find it in the bed of a ravine, and many years ago a captain of a vessel is said to have got some hundreds-weight of it. Now, however, it is evidently very scarce, as during the two years, Mr Geach resided in the country, none was found. I was shown one piece several pounds' weight, having much the appearance of one of the larger Australian nuggets, but of pure copper instead of gold. The natives and the Portuguese have very naturally imagined, that where these fragments come from there must be more; and they have a report or tradition, that a mountain at the head of the ravine is almost pure copper, and of course of immense value.

After much difficulty a company was at length formed to work the copper mountain, a Portuguese merchant of Singapore supplying most of the capital. So confident were they of the existence of the copper, that they thought it would be waste of time and money to have any exploration made first, and accordingly sent to England for a mining-engineer, who was to bring out all necessary tools, machinery,

laboratory, utensils, a number of mechanics, and stores of all kinds for two years, in order to commence work on a copper-mine which he was told was already discovered. On reaching Singapore a ship was freighted to take the men and stores to Timor, where they at length arrived after much delay, a long voyage, and very great expense.

(To be continued)

A.R. Wallace
The Malay Archipelago, 1869